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CLAIMS

[Claim(s)]
[Claim 1] In the image generation method which generates the resolution picture of the predetermined number of bits which restores said subject-copy image on said 1st color space when the subject-copy image on the 1st color space is changed into the image on the 2nd color space and inverse transformation of this conversion is performed The pixel value of an resolution picture expands the width of face of an expression possible value by setting said predetermined number of bits as more numbers of bits than the number of bits of said subject-copy image. By mapping each pixel value acquired by said conversion in the value which added the predetermined value to this each pixel value The image generation method characterized by generating the resolution picture holding the information about the pixel used as the pixel which serves as a larger value than the maximum of an expression possible value with the same number of bits as said subject-copy image by said conversion, and/or a negative value.
[Claim 2] In the image generation equipment which generates the resolution picture of the predetermined number of bits which restores said subject-copy image on said 1st color space when the subject-copy image on the 1st color space is changed into the image on the 2nd color space and inverse transformation of this conversion is performed A number-of-bits setting means by which the pixel value of an resolution picture expands the width of face of an expression possible value by setting said predetermined number of bits as more numbers of bits than the number of bits of said subject-copy image, By mapping each pixel value acquired by said conversion in the value which added the predetermined value to this each pixel value Image generation equipment characterized by having an resolution picture generation means to generate the resolution picture holding the information about the pixel used as the pixel which serves as a larger value than the maximum of an expression possible value with the same number of bits as said subject-copy image by said conversion, and/or a negative value.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the approach and equipment which

generate the image which exchanges the image with which the digital output was carried out in the lab and the customer was provided between a lab and a customer in digital-input/output service of a photograph which carries into a lab again behind and carries out a printed output.

[0002]

[Description of the Prior Art] Conventionally, the digital output service with which records the image data read in the film developed negatives etc. on media, such as CD-R and MO, and a customer is provided is known. Moreover, to the image data outputted by the above-mentioned service, a customer processes it using a personal computer and the digital input service which carries processed data into a lab and is reproduced as a photoprint is also known.

[0003] Here, it depends for the color space (color system of coordinates) for expressing an image on the device which generally deals with the digital image. That is, the system of a lab has managed the image by the color system of coordinates suitable for dealing with the image which carries out a printed output, and when the CRT display of the personal computer etc. is carried out, it has managed the image by color system of coordinates which are displayed with sufficient appearance. For this reason, with the above-mentioned digital-input/output service, in case an image is outputted, in the world of a personal computer, color conversion to a standard color space (henceforth a standard color space) is usually performed to the system of a lab from the color space (henceforth objective color space) of a proper. Moreover, when reinputting and carrying out the printed output of this image to the system of a lab, conversion to objective color space from a standard color space is performed on the contrary.

[0004]

[Problem(s) to be Solved by the Invention] Since the pixel value of an image is held as data of the predetermined number of bits, respectively, the value which a pixel value can take is restricted by the number of bits, for example, if it is 8-bit data, it will be restricted to the integral values from zero to 255. However, it does not restrict that the value acquired as a result of changing the above-mentioned color space to this digital image turns into a value of the not necessarily same range, but adjustment of transposing a negative value to 0 and transposing 256 or more values to 255 at the time of conversion, is performed. For this reason, even if it carries out inverse transformation of the image once changed into the standard color space to objective color space, it does not restrict being restored completely, but a restoration error produces it. This is one cause of degrading the image quality of a print.

[0005] In case this invention generates an image which is behind used for print creation in a lab in view of the above-mentioned trouble, it aims at offering the image generation method and equipment which generate an image which holds sufficient information in order to generate a high-definition print.

[0006]

[Means for Solving the Problem] The image generation method of this invention changes the subject-copy image on the 1st color space into the image on the 2nd color space. In the image generation method which generates the resolution picture of the predetermined number of bits which restores said subject-copy image on said 1st color space when inverse

transformation of this conversion is performed The pixel value of an resolution picture expands the width of face of an expression possible value by setting said predetermined number of bits as more numbers of bits than the number of bits of said subject-copy image. By mapping each pixel value acquired by said conversion in the value which added the predetermined value to this each pixel value It is characterized by generating the resolution picture holding the information about the pixel used as the pixel which serves as a larger value than the maximum of an expression possible value with the same number of bits as said subject-copy image by said conversion, and/or a negative value.

[0007] Here, "the 1st color space" specifically means the color space of the system proper of a lab. "The subject-copy image on the 1st color space" is the digital image data acquired by the film scanner etc. in the lab.

[0008] On the other hand, "the 2nd color space" is a standard color space at the time of an image being dealt with with a personal computer. Although said subject-copy image is changed into "the image on the 2nd color space" and "the resolution picture of the predetermined number of bits" is generated, you may not necessarily be said predetermined number of bits, and the number of bits at the time of transform processing (operation precision) generates the image of the number of bits which is on the 2nd color space by conversion, and finally, with "the predetermined number of bits", I hear that it is recorded on media etc. and there is.

[0009] In addition, the number of bits of an image is the number of bits assigned to the pixel value (the case of a color picture R, G, B of each pixel respectively) of each pixel which constitutes an image here, and the number of gradation of an image (precision) is determined. It is got blocked, for example, although each pixel value turns into a value (for example, value of 0-255) which can be expressed by 8 bits when it is the image whose number of bits is 8 bits, the number of gradation of this image will be called 256 gradation in this case.

[0010] Saying that is, "the pixel value of an resolution picture expands the width of face of an expression possible value by setting the predetermined number of bits as more numbers of bits than the number of bits of said subject-copy image" If the number of bits of an resolution picture is made into the same 8 bits as a subject-copy image and the image after conversion will also make the number of bits of an resolution picture 9 bits to being expressed by only 256 gradation 512 gradation can express the image after conversion, I hear that the amount of information which can be held also increases twice, and it has it.

[0011] Here, this invention tends to express the range of a color larger than the range of the color which did not express in a detail the same range as the range of the color currently expressed with 256 gradation in the subject-copy image with 512 gradation, but was expressed with 256 gradation with 512 gradation. It is because the image obtained by conversion is not necessarily settled in the range of the same color when this changes a color space, since color reproduction regions also differ if color spaces differ.

[0012] That is, that white is 0, for example defined a certain color as white, and it assigned the value 0 to the color. Therefore, in a different color space, a color still whiter than the white expressed by 0 may exist. That is, it is going to hold this invention as it is about the pixel used as a color (256 or more values) still deeper than a color (negative value) still whiter than the color expressed by 0 by changing a subject-copy image, or the color

expressed by 255, without approximating the information to 0 or 255.

[0013] As a concrete means for this, a pixel value is mapped as mentioned above with the image generation method of this invention. For example, when changing a 8-bit subject-copy image like the above-mentioned example and generating a 9-bit resolution picture, 128 is added to the pixel value after conversion, and if it maps so that 0 may be set to 128 and 256 may be set to 384, a negative value is held as a value of the range of 0 to 127, and can be held as a value of the range of 384 to 511 also about 256 or more values. In case this restores a subject-copy image from an resolution picture, an image more faithful to a subject-copy image can be reproduced by using such information.

[0014] In addition, in order to make an understanding easy, although the number of bits of 8 bits and an resolution picture was explained for the number of bits of a subject-copy image as 9 bits, the approach and equipment of this invention are not limited to these numbers of bits.

[0015] Moreover, the image generation equipment of this invention changes the subject-copy image on the 1st color space into the image on the 2nd color space. In the image generation equipment which generates the resolution picture of the predetermined number of bits which restores said subject-copy image on said 1st color space when inverse transformation of this conversion is performed A number-of-bits setting means by which the pixel value of an resolution picture expands the width of face of an expression possible value by setting said predetermined number of bits as more numbers of bits than the number of bits of said subject-copy image, By mapping each pixel value acquired by said conversion in the value which added the predetermined value to this each pixel value It is characterized by having an resolution picture generation means to generate the resolution picture holding the information about the pixel used as the pixel which serves as a larger value than the maximum of an expression possible value with the same number of bits as said subject-copy image by said conversion, and/or a negative value.

[0016] In addition, although there is the approach of expressing more the range of the same color as a subject-copy image in a detail by increasing the number of bits as a general approach for raising the restoration precision of an image, this invention may be combined as such an approach and may be carried out. For example, the number of bits of 8 bits and an resolution picture is made into 10 bits for the number of bits of a subject-copy image, and the field of the same color as a subject-copy image is expressed by 9 bits at a detail (in twice as many precision as this), and you may make it assign it to the expression of the further remaining colors with the color of a subject-copy image out of range 1 bit.

[0017]

[Effect of the Invention] The image generation method and equipment of this invention generate an resolution picture with more numbers of bits than the number of bits of a subject-copy image, and in this case, since each pixel value is mapped in the value which added the predetermined value to that pixel value Information which will be lost when an resolution picture is generated with the same number of bits as the information about the pixel which serves as a larger value and/or a negative larger value than the maximum of an expression possible value with the same number of bits as a subject-copy image, i.e., a subject-copy image, can be held as it is. Thereby, in case a subject-copy image is restored, the high restoration image of precision can be obtained more by using such information.

[0018]

[Embodiment of the Invention] Hereafter, the image generation method and equipment of this invention are explained with reference to a drawing. Drawing 1 is drawing showing the outline of digital-input/output service. The image handling equipment 3 and the photograph printer 4 in drawing are a device installed in a lab 1, and a personal computer 7 is installed in a customer's home 2 etc.

[0019] In the gestalt of this operation, image handling equipment 3 is the general-purpose personal computer with which the exclusive program was incorporated, and is equipped with the film scanner for reading a developed film as a peripheral device. Furthermore, this image handling equipment 3 is equipped with the media drive of CD-R, Zip, etc. by built-in or external. Moreover, it also has the communication equipment (not shown) for exchanging other computers and images through a network.

[0020] The photograph printer 4 is a well-known digital photography printer, receives an image and output directions information (for example, print number of sheets, size, etc.) from image handling equipment 3, and performs a printed output based on these.

[0021] In the above-mentioned system, the image captured from the developed film by image handling equipment 3 is changed into the image on the standard color space suitable for a CRT display from the image on the objective color space of the system suitable for a printed output, and is outputted to the media 6, such as CD-R, as an image file.

[0022] The image file by which the media output was carried out can be used on a customer's personal computer 7. That is, by displaying the image recorded on media 6 on CRT of a personal computer 7, a customer chooses the image which carries out a printed output, for example, and ordering information can be created or he can process it into an image using commercial retouching software.

[0023] The image file which is processed on the image file recorded on the above-mentioned media 6 or a personal computer, and was resaved to other media can be outputted as a print 5 by incorporating to the image handling equipment 3 of a lab again. Under the present circumstances, since the incorporated image file is an image on a standard color space, color conversion to objective color space is performed by image handling equipment 3.

[0024] As mentioned above, it is the approach of generating the image for a file output from the photograph incorporated from the film etc. in such service, and aims at generating an image with which a high definition photoprint is obtained like the case where the immediate printing output of the image captured from the film when the image generation method of this invention reproduced the image as a photoprint is carried out although the outline of digital-input/output service was explained.

[0025] In addition, although the following explanation is related mainly with the image generation method of this invention, the image generation equipment of this invention is realizable by including the program which performs processing explained below in the above-mentioned image handling equipment 3.

[0026] The gestalt of the operation explained below asks for the number of bits which can hold image information sufficient about the range of the same color as a subject-copy image first, and makes the number of bits with much 1 more bit the number of bits of an

resolution picture rather than the number of bits. That is, it is going to raise restoration precision further by combining the approach of increasing the number of bits and expressing the same color reproduction region in a higher precision, and the approach of this invention.

[0027] First, the procedure of setting up the number of bits of an resolution picture is explained. Drawing 2 is a flow chart which shows this procedure. the start -- the film developed negatives -- a film scanner -- the precision of 8 bits or more (for example, 10 bits) -- reading -- this reading image -- predetermined setup processing -- the color space of a system proper (print proper) -- changing -- R, G, and B -- a 8-bit subject-copy image is acquired, respectively (step 101). Here, in order to carry out the media output of the subject-copy image since Above R, G, and B is R, G, and B in the color space of a system proper, and to enable it to use it with a personal computer etc., it needs to perform conversion to a standard color space. With the gestalt of this operation, the temporary law (initialization) of the number-of-bits N of the resolution picture acquired by conversion is carried out to the same 8 bits as a subject-copy image (step 102).

[0028] Next, in step 103, the above-mentioned subject-copy image is changed into a standard color space from objective color space. Under the present circumstances, number-of-bits N of an resolution picture carries out to the number of bits by which the temporary law was carried out in the above-mentioned step 102, i.e., 8 bits. Next, the 8-bit resolution picture on this standard color space is again changed into the image on objective color space, and a subject-copy image is restored (step 104). In addition, although 3x3 matrices are performing conversion of a color space with the gestalt of this operation, in this invention, especially the concrete approach of color conversion may not be limited, for example, the approach using a three-dimension look-up table etc. is sufficient as it.

[0029] Next, in step 105, the difference of the pixels which correspond about the restoration image and subject-copy image which were generated on objective color space is calculated, and distribution of the value is searched for. In step 106, it judges whether the distribution which made the restoration error the inside of tolerance and less than **two pixels searched for when the difference of pixels occupied 90% or more is filling this condition with the gestalt of this operation.

[0030] Usually, in the same number of bits as a subject-copy image, it is large and, in restoration precision, a quantization error does not become not much high. Therefore, conditions should be fulfilled in step 106 here. In this case, in step 107, number-of-bits N of an resolution picture is reset as 9 bits from 8 bits, and the number of bits of an resolution picture is repeated for processing from step 103 or subsequent ones to step 106 as 9 bits. Hereafter, every one number of bits of an resolution picture is increased, and the above-mentioned processing is repeated until conditions are fulfilled in step 106.

[0031] Less than **2% of pixel makes the number of bits with more 1 bit than the number of bits the number of bits of an resolution picture, when an error becomes 90%, as a result of increasing the number of bits of an resolution picture (step 108).

[0032] Next, mapping processing of a pixel value is explained. Drawing 3 is drawing showing the range of the pixel value of each pixel which constitutes an image. That is, 0, 256, 512, 768, and 1023 are the graduations of the range of a pixel value, for example, when the range 11 saves an image by 9 bits, the value which each pixel can take shows

that it is the range of 0 to 511.

[0033] For example, in the flow chart of said drawing 2 , when number-of-bits N is 9 bits, suppose that the conditions of step 106 were fulfilled. In this case, in step 108, the number of bits of an resolution picture is set as 10 bits added to 9 bits 1 bit.

[0034] When an resolution picture is generated as a 9-bit image, the value which each pixel value of an resolution picture can take is a value between 0 and 511. However, when changing a color space, as for the result of conversion, the range 12 of drawing 3 can become a negative value and 512 or more values as mentioned above.

[0035] On the other hand, with the gestalt of this operation, a pixel value is mapped so that 0 may be set to 256 and 512 may be set to 768, and an resolution picture is generated as a 10-bit image. Since the value which can be expressed by 10 bits is from 0 to 1023 as shown in the range 13 of drawing 3 , if the range 12 is mapped in the range 13 as shown in drawing, it will be lost that a part of image information will be omitted by conversion.

[0036] By this approach, when the number of bits of an resolution picture and the value (it is 256 and 512 at the example of drawing 3) used as the criteria in the case of mapping are saved with an image and create a photoprint from this file, based on this information, conversion to objective color space from a standard color space is performed to the outputted image file, and a subject-copy image is restored to it.

[0037] As explained above, from a file, the approach of this invention can raise the restoration precision at the time of restoring the image for a print, and contributes to the spread of digital photography services greatly.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the outline of digital-input/output service

[Drawing 2] The flow chart which shows the procedure of number-of-bits setting processing of an resolution picture

[Drawing 3] Drawing for explaining the image generation method of this invention

[Description of Notations]

1 Lab
2 General Home
3 Image Handling Equipment
4 Photograph Printer
5 Photoprint
6 Media
7 Personal Computer
8 Film Developed Negatives